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BELIEFS AND BROWNIES:
IN SEARCH FOR A NEW IDENTITY FOR ‘BELIEF’ RESEARCH

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Belief research (BR) has contributed to a better understanding of teachers’ acts and meaning making, but is fraught with conceptual and methodological problems. Further, the premise that teachers’ beliefs impact practice is often not confirmed. I compare BR with a conceptual framework, Patterns of Participation (PoP), that shifts the focus from teachers’ beliefs to their participation in a variety of social practices. In order to do so, I first discuss modalities of theory networking and present a general approach to comparing theories and frameworks. The result of the comparison is that PoP shares some of the rationale of BR, but involves a fundamental shift of identity for research on affect, which alleviates some of the problems of BR and is useful for understanding the dynamics of teachers’ contribution to classroom practice.

Lester & Lambdin (1998) draw on two different metaphors to describe developments in mathematics education research. The first, known since the times of ancient Greece, is the story of Theseus whose ship lies in the port of Piraeus. The ship needs repair, and one of the planks is removed and replaced by another. This certainly does not change the ship much; it is still Theseus’ ship. However, over time more planks are replaced, and in the end none of the original planks are left. The question is whether the ship now lying in the harbour is still Theseus’ ship. The other metaphor is about a brownie baker, who gradually changes the ingredients of his delicacies, replacing butter with margarine, whole eggs with an egg substitute, and chocolate with carob. But when does changing the ingredients one by one turn the products on display in the baker’s shop window into commodities that can no longer be called brownies?

Lester & Lambdin use the metaphors to frame a discussion of seven quality criteria for evaluating mathematics education research and – more specifically – for reviewing manuscripts submitted to the Journal for Research in Mathematics Education. In the present context I use them for a somewhat different purpose, namely as a (slightly rhetorical) backdrop for comparing and contrasting two different approaches to research on affect in mathematics education, those of mainstream belief research and of a recent conceptual framework called Patterns of Participation (PoP). The main aim is to discuss the mutual relationships and possible (in-)compatibility of the two approaches, as this may highlight significant developments as well as possible ways ahead for the field of affect in mathematics education. The comparison is made with reference to research on and with teachers of mathematics.

I begin by considering some defining characteristics of any field of study. To stay with the metaphors above, these characteristics constitute ‘the planks of the ship’ or ‘the ingredients of the brownie’, as without them there is no ship or brownie and if changed...
dramatically, the result will no longer be recognised as the same as the original. Following from that, I discuss the main characteristics of mainstream belief research and recapitulate parts of a critique of this field. Subsequently, I outline the PoP-framework, before comparing and contrasting the two approaches.

**THEORY NETWORKING**

Research in mathematics education draws on a long list of theoretical imports while seeking to develop a range of what Steiner refers to as homegrown theories (Steiner, 1984). This situation calls for a discussion of the tensions and possible compatibility between different theoretical perspectives (Cobb, 2007; Gellert, 2008; Radford, 2008) and of what Bikner-Ahsbahs & Prediger (2010) call approaches to theory networking. Bikner-Ahsbahs & Prediger order such approaches on a scale of theory integration and position them between the poles of ‘ignoring other theories’ and ‘unifying [theories] globally’. Cobb’s and Yackel’s coordination of constructivist, interactionist, and socio-cultural analyses in their emergent perspective on classroom processes and student learning is a classic example of an approach that may be placed towards the higher end of the scale (Cobb & Yackel, 1996). Networking strategies positioned towards the lower end of the scale include ‘comparing’ and ‘contrasting’ theories or approaches. In this paper I compare and contrast mainstream belief research and PoP.

Bikner-Ahsbahs & Prediger suggest that it may serve three different purposes to compare and contrast theoretical approaches, namely to engage in inter-theoretical communication so as to improve understandings of the theories involved; to function as a less laudable “competition strategy on the market of available theories and theoretical approaches”; and to provide ”a rational base for the choice of theories” (Bikner-Ahsbahs & Prediger, 2010, p. 493, emphasis in the original). My intention when comparing and contrasting mainstream belief research and PoP is to achieve all three, although modifications are needed in relation to the two last purposes. My concern with the second purpose, to promote one at the expense of another, is not based on the premise that one approach is ‘more true’ than the other in any absolute sense. I merely suggest that PoP is helpful in addressing some of the problems that have faced belief research and that it offers a useful and qualitatively different understanding of unfolding classroom events. With regard to the third purpose, the rationality of the endeavour, rationality in the present context merely means making justified decisions for the pragmatic purpose of theorising classroom processes, when those processes are seen from a certain vantage point.

Also considering modes of theory integration, Radford (2008) suggests that theories may be thought of as triples of basic Principles, Methodologies, and paradigmatic Questions. The Principles constitute a hierarchically ordered system of views and statements that “delineate the frontier of what will be the universe of the discourse and the adopted research perspective” (p. 320). The Methodology is not merely the methods used and the reasons for using them, but the process through which particular aspects of or relationships in, for instance, an interview transcript or a video-recorded
lesson become data, that is, worthy of attention in the interpretation. In this sense Methodology is linked to the theoretical stance and the unit of analysis. Finally, the paradigmatic Questions are the ones that initially orient the field and that leave an imprint on the approach taken to other questions that are phrased in subsequent studies that build on the theory. Radford uses the triples, (P,M,Q), to consider ways in which theory networking may be accomplished, and refers, for instance, to when the Principles of one theory are connected with the Methodology of another.

It is beyond the present paper to discuss the controversial question of what is required for a framework to generate or qualify as theory, apart from making the, probably uncontentious, observation that neither belief research nor PoP does so at present. In spite of that, I refer to Radford’s (P,M,Q) triple, among other perspectives on theories and frameworks, in my comparison of belief research and PoP, implying that I also find the triple useful when discussing frameworks that do not qualify as a theory.

COMPARING AND CONTRASTING FRAMEWORKS

In order to address the question of how one may compare or contrast conceptual frameworks and the way they are used in empirical studies, an outline is needed of what a conceptual framework is and how it is related to other aspects of the process of inquiry. According to Miles and Huberman (1994) a conceptual framework “explains, either graphically or in narrative form, the main things to be studied […] and the presumed relationships between them” (p. 18). While this suggests that conceptual frameworks are somewhat descriptive accounts of the selected key concepts and variables and of their mutual relationships, Eisenhart (1991) focuses more on the reasons for the selection. She argues that a conceptual framework is

“an argument that the concepts chosen for investigation and interpretation and any anticipated relationships among them, will be appropriate and useful, given the research problem under investigation” (p. 209, emphasis added).

For the purposes of this paper, I suggest – more in line with Eisenhart than with Miles & Huberman – that there are three aspects to a conceptual framework. These are $F(1)$: a preliminary understanding of the concepts involved and of the relationships between them; $F(2)$: a (possibly loosely organised) theoretical stance that orients the interpretations of these concepts and other aspects of what Radford calls Principles; and $F(3)$: the overall rationale, that is, a justification that it is worthwhile to engage in the field of inquiry. Such a rationale may be based on practical problems of mathematical teaching and learning, on significant scholarly literature in the field under investigation, or on some combination of the two. The emphasis on $F(2)$ and $F(3)$ in this understanding of a framework implies that different frameworks may not ‘speak the same language’, even when they use the same or similar terminology. ‘Learning’ or ‘development’, for instance, are key concepts that are linked to ‘social interaction’ in a variety of decidedly incompatible frameworks, the differences among them becoming apparent only if the theoretical stance, $F(2)$, and the rationale, $F(3)$, are taken into account. As frameworks develop and are used for empirical purposes, they
may also come to include what Radford calls paradigmatic questions \( F(4) \) and aspects of methodology \( F(5) \).

In this understanding a conceptual framework orients specific empirical studies by suggesting the key constructs under investigation, as well as the perspective from which they are viewed. This implies that in any particular study the framework is reflexively related to the research questions, to the unit of analysis, as well as to the methodology, that is, to the design and the processes of data generation and analysis (Skott, 2013). This understanding of methodology is much in line with Radford’s interpretation as outlined previously, as it includes M(1): the methods used; M(2): the reasons for using them; and M(3): the question of what data are generated from an empirical situation. The relationships among the framework and other aspects of a field of inquiry are depicted in figure 1.

![Figure 1: Frameworks and other aspects of a field of inquiry](image)

It follows that a comparison of research on teachers’ beliefs and PoP should highlight differences and similarities concerned with the three (or five) aspects of the respective frameworks as well as the relationships among the frameworks and the dominant research questions, the units of analysis and the methodology. I begin by describing research on teachers’ beliefs in these terms.

**RESEARCH ON TEACHERS’ BELIEFS**

Different fields of research specify each of the elements of the proposed comparison to different degrees. Research on teachers’ beliefs, for instance, is basically defined by its key concept, that of beliefs, and studies in the field do not always specify the character of other aspects of the framework used, especially the theoretical stance. The first task, therefore, is through a somewhat abductive approach to suggest the character of this stance based on an outline of other parts of the framework as well as of the unit of analysis, the main research questions, and the dominant methodology. The analysis suggests that research on teachers’ beliefs is framed by an acquisitionist approach
often inspired by constructivism, and even when informed by more social interpretations of human functioning, frameworks are still inspired by acquisitionism.

**Researching teachers’ beliefs**

Developing from the early 1980s onwards research on teachers’ beliefs aimed both to understand teachers’ actions and meaning making as they relate to classroom practice and to solve or at least alleviate what is generally referred to as ‘the problems of implementation’ (Skott, 2015a). These aims, often somewhat at odds with one another, constitute the basic rationale of the field as it has developed over the last three decades.

The key concept of beliefs is also the main unit of analysis. Sometimes the emphasis is on individual beliefs, for instance about the contents of instruction, while in others it is on structural aspects of belief systems (cf. Zembylas & Chubbuck, 2015). Studies of the latter draw, for example, on Rokeach (1969), a social psychologist whose contributions were made before research on teachers’ beliefs gained prominence. Rokeach developed a framework for conceptualising the relationships between beliefs, attitudes and values. Much later, and working in mathematic education, Goldin (2002) also suggested a conceptualisation of the relationships between different concepts related to the affective domain, namely of beliefs, values, attitudes and emotions. In Goldin’s framework these differ on the three dimensions of how cognitive, how stable, and how “warm” they are. I have suggested elsewhere (Skott, 2015a) that irrespective of the relative emphasis on individual beliefs and on structural aspects of belief systems, the concept of beliefs is still underspecified. This is so even though there is a core to how the concept is used, as beliefs generally refer to those of an individual’s mental constructions that are (1) subjectively true; (2) affectively laden; (3) outcomes of substantial prior experiences; and (4) significant determiners of the individual’s actions and meaning making. Beliefs, then, are mental constructs characterised by considerable degrees of conviction, commitment, stability, and impact (Skott, 2015a).

One set of questions in belief research focuses on the character of teachers’ beliefs about mathematics and the teaching and learning of mathematics as well as about the teachers themselves as learners, teachers, and doers of mathematics. Another set of questions, related to belief stability, is concerned with how beliefs change as teachers engage in teacher education or development programmes or move into full time teaching. It is often assumed that belief change is a long term endeavour that resembles conceptual change in cases when accommodation is difficult to achieve. A third and final set of questions concerns how teachers’ beliefs function in relation classroom practice. Fives & Buehl (2012) argue that beliefs serve different functions, as some filter information, others frame problems, and still others guide action. Also addressing the last set of questions, Thompson (1984) asked:

“1. Are there incongruities between teachers’ characteristic instructional behavior and their professed conceptions of mathematics teaching?
2. How can incongruities between teachers’ professed conceptions and their instructional practices be explained?”
3. Are differences among the teachers in their characteristic instructional practices related to differences in their beliefs and views about mathematics and mathematics teaching?” (Thompson, 1984, p. 107).

Thompson’s paper signalled the introduction of research on teachers’ beliefs in mathematics education, and her questions are paradigmatic in Radford’s sense (cf. the previous discussion) or at least exemplary for the questions asked in the larger part of the field. In this sense they have become part of the framework and orient the overall approach taken in the field of beliefs. The questions are based on the premise that beliefs are the default explanation for classroom practice and explicitly address the corollary that observed incongruities require further explanation (Skott, 2015b).

With regard to methods, it is acknowledged that beliefs are not easily accessed (Kagan, 1990; Richardson, 1996). They are inferred from or attributed to teachers on the basis of different data sources, including questionnaires, interviews, think aloud protocols, and classroom observations. Multiple methods are needed, so as to view teachers’ beliefs from a variety of different perspectives (Kagan, 1990; Schraw & Olafson, 2015). The use of such combinations of methods indicate that the field is generally in line with Rokeach’s remark that a belief is “any simple proposition […] inferred from what a person says or does, capable of being preceded by the phrase ‘I believe that’” (Rokeach, 1969, p. 113). It also implies that the different methods are expected to shed light on the same set of beliefs as viewed from different vantage points.

I suggested previously that \( F(2) \), the theoretical stance in belief research, is not always made explicit. However, from time to time reference is made to constructivism and the literature on conceptual change as a sources of inspiration in studies of teachers’ beliefs (e.g. Kagan, 1992). The above outline of the rationale, the unit of analysis, the exemplary questions, and the dominant methodological stance suggests that in general the field is informed by basic constructivist tenets of assimilation, accommodation, and mental disequilibria even when no such reference is made explicit. Belief research, then, extends Glasersfeld’s comment that radical constructivism is based on the premise that knowledge “is in the heads of persons” (von Glasersfeld, 1995, p. 1). In belief research, beliefs that do not qualify as knowledge because of the subjectivity of the truth claim and of its more value-laden character are also conceived of as mental entities located in the head of the individual. It is, then, no coincidence that research on teachers’ beliefs developed in tandem with the constructivist revolution of the 1980s.

In summary, beliefs are considered objectified mental entities that reside within the individual and that take on a life of their own which is independent of the experiences on which they were initially based. In this sense the outline suggests that belief research is based on acquisitionism as a metaphor for human functioning, that is, on a metaphor that “make[s] us think of knowledge as a kind of material, of the human mind as a container, and of the learner as becoming an owner of the material stored in the container” (Sfard, 2008, p. 49).
The problems of belief research

In spite of the progress made in the field of beliefs, it is still a problematic endeavour. The unit of analysis, individuals’ beliefs, is ill-defined and hardly operationalisable; it is acknowledged that the methods do not provide immediate access to these elusive constructs; and one part of the rationale, the expectation of belief impact, is refuted as much as confirmed in empirical studies (Fives & Buehl, 2012). One may wonder why the field is not in a crisis.

As a response to the last of these problems, different scholars have adopted less causal and more dynamic interpretations of the beliefs-practice quandary and reconsidered the expectations of belief stability and belief impact, that is, of the last two of the core characteristics of beliefs (cf. the previous discussion) (Skott, 2015b). Hoyles (1992), Cobb & Yackel (1996), Skott (2001), Sztajn (2003), and Schoenfeld (2011) among others, acknowledge that beliefs about mathematics and its teaching and learning do not necessarily determine practice, and that the degree of influence depends on contingencies arising in classroom and on the relationships among beliefs and other mental constructs. However, these scholars all rely on some form of acquisitionism, albeit in different ways and to different degrees (Skott, 2015b). In this sense they do not challenge the dominant theoretical stance in the field of beliefs.

One part of the background to the Patterns of Participation framework (PoP) described below is also an attempt to address the three problems of belief research that are mentioned above. Doing so, however, PoP adopts a more participatory stance to researching teachers and teaching.

PATTERNS OF PARTICIPATION (POP)

As in research on teachers’ beliefs, a dominant part of the rationale of PoP is to develop understandings of teachers’ acts and meaning making as they relate to classroom interaction. Also, and in line with recent studies of beliefs, PoP addresses the problem of the lack of support to the congruity thesis. However, in contrast to mainstream belief research PoP finds the conceptual and methodological problems of the field of beliefs equally disturbing and also suggests that the acquisitionist stance is ill-suited to be combined with recent approaches to the study of teachers’ professional identities (Skott, 2013). Further, a number of recent and somewhat grounded studies of belief-practice relationships have challenged the acquisitionist underpinnings of belief research (Skott, 2004, 2009; Wedege & Skott, 2006).

PoP is, then, an attempt to develop a more participatory account of the functioning of teachers in mathematics classrooms. The key concepts of the framework include those of practice, participation, and figured worlds from social practice theory (Holland, Skinner, Lachicotte Jr, & Cain, 1998; Lave, 1988, 1997; Wenger, 1998) and of objectification and discourse in Sfard’s recent theory of commognition (Sfard, 2008).

1 For a more comprehensive introduction to the background of PoP, see Skott (2013).
However, both social practice theory and the theory of commognition need to be supplemented to be useful for PoP-purposes. While the understanding of practice and participation in social practice theory is not a “displacement of the person” (Wenger, 2010, p. 181), I suggest that there is a need to re-centre the individual both in social practice theory and in Sfard’s account of learning. Further, Sfard’s emphasis is on well-structured, socio-cultural discourses (e.g. mathematics) and needs to be supplemented with a concern for the role of other practices and figured worlds in and for immediate social interaction when considering less structured practices such as teaching. I have found the I-me dynamic in the symbolic interactionist notion of self helpful for both purposes (Blumer, 1966, 1969; Mead, 1913, 1934).

According to symbolic interactionism interaction is based on the human ability to take the attitude of individual and generalised others to ‘objects’ in their environment. As we act, we view the objects of our interactions as well as ourselves through the eyes of other interlocutors, both present and absent, and we modify our actions based upon their indications about what is important and why. Consider, for example, a teacher working with a group of students, who are trying to substantiate a mathematical conjecture, but find it difficult to do so (cf. Skott, 2015b). The teacher anticipates and interprets the words, the tone of voice, the raised eyebrows, etc. of the students in the class. However her contributions to the interaction may change if she, while engaged in a mathematical discourse to assist the students, also orient herself towards a proposal for educational reform promoted by her teacher education programme; positions herself in a team of teachers whose collaboration focuses on the well-being of individual students rather than on their subject-matter learning; and attempts to document her mathematical expertise, as her subject matter competence was recently questioned at a PTA meeting. In symbolic interactionist terms, the teacher takes the attitude of different individual and generalised others (the students, the teacher education programme, her team, the parents) and draws upon and renegotiates the meaning of the related social practices and discourses in the process. The theoretical stance of PoP, then, coordinates key understandings from social practice theory and commognition with others inspired by symbolic interactionism.

These theoretical sources of inspiration and the intention of re-centring the individual imply that the key unit of analysis is the individual in multiple practices and figured worlds. Exemplary research questions for PoP include: What roles, if any, do a teacher’s tales of herself as a professional play for how she engages the students in endorsing mathematical narratives? How, if at all, does her relationship to educational discourses (e.g. the reform) modulate how she and her students negotiate the meaning of mathematical proficiency? How, if at all, does collaboration with her colleagues play a part in how she positions herself in relation to the students? (Skott, 2013).

The methods used in PoP are partly the same as the ones used in belief research and include interviews with and classroom observations of the teacher in question. As deemed necessary in the particular study, these are supplemented with for instance interviews with the teacher’s colleagues and the school leadership and with
observations of informal exchanges in the staff-room, of meetings in teams of collaborating teachers, and of teacher development sessions (Skott, 2011, 2013). However, in belief research different methods are used for triangulation purposes, that is, to provide “multiple lenses on the same phenomena” (Schoenfeld, 2007, p. 87). In contrast, PoP does not use multiple methods because they are expected to shed light on the same construct of beliefs, but exactly because they provide at least some access to how the teacher engages in different practices and figured worlds. An interview conducted in the researcher’s office, for instance, may engage the research participant in an educational discourse on a reform agenda, while a team meeting may constitute a very different practice that is only remotely, if at all, related to current reform initiatives. Classroom observations are the key mode of data generation and the teacher’s acts and meaning making are interpreted in terms of the role of, for instance, the reform discourse and of her collaboration with her colleagues for her contributions to the practices that emerge at the instant. In symbolic interactionist terms, these and other discourses and figured worlds may (and may not) play the role as significant generalised others for the teacher in question as classroom interactions unfold. It is apparent, then, that while the methods used, $M(1)$, in belief research and in PoP are largely the same, the reasons for using them, $M(2)$, are very different and so are the data that are generated from the empirical situation, $M(3)$.

SUMMARY AND CONCLUSIONS

It is apparent from the outlines above that there is a common element to the rationale of mainstream belief research and PoP: Both attempt to understand individual teachers’ acts and meaning making. In spite of that, the theoretical stance differs significantly between the two fields. Further, key notions (e.g. practice) are interpreted differently, and while belief research sees meaning-making as based on objectified mental constructs, PoP adopts a processual perspective and considers it a matter of reengaging in other social practices in view of the interactions that unfold at the instant. These differences lead to qualitatively different units of analysis (objectified mental constructs vs. person in multiple practices) and paradigmatic research questions, and although the methods are similar, they are used for decidedly different purposes.

As mentioned before, a number of attempts have been made in belief research to address the beliefs-practice quandary by adopting less causal and more dynamic interpretations of the relationship between teachers’ beliefs and instructional activity (Lerman, 2001; Schoenfeld, 2011; Sztajn, 2003). Generally, these attempts do not challenge the basic rationale or other parts of the acquisitionist framework. Returning to the metaphors in the introduction of this paper, they may replace a plank or two in the ‘ship’ of belief research or change a single ingredient in the recipe of the ‘brownie’. Belief research, however, is still belief research. My argument is that PoP is not. The framework is fundamentally changed and so are the exemplary research questions and the unit of analysis, and the methodology is altered to the extent that what constitutes data is different even if the methods used may be superficially similar.
I argued previously that there are two sides to the rationale of belief research, as it aims both to understand teachers’ actions and meaning making and to solve ‘the problems of implementation’. PoP research shares the first aim, and my colleagues and I have used the PoP framework for empirical purposes and argued that it offers a dynamic and contextual perspective on the acts of teaching that cannot be developed in mainstream belief research (Palmér, 2013; Skott, 2013; Skott, Larsen, & Østergaard, 2011). One may wonder, how PoP relates to the other part of the rationale of belief research, that is, to the ambition of solving the ‘problems of implementation’. From a PoP perspective ‘implementation’ is a problematic metaphor, as it carries connotations of the smooth execution of a plan or idea. But if practices in schools and classrooms are emerging and continuously renegotiated, a reform initiative, for instance as discussed in a teacher development programme, can hardly be expected to be ‘implemented’. It may function as yet another generalised other that teachers may draw on as classroom processes unfold. But there is little reason to expect a priori that the initiative dominates the acts of teaching, let alone the communal practices that evolve in the classroom.

This may seem a disappointing conclusion. After all, mathematics education research is expected to contribute both to the development of new understandings of teaching-learning processes and to the further development of these processes. The comments above suggest that PoP has little to offer in terms of the latter of these intentions. However, PoP does not imply that mathematics education research should not attempt to influence practice. It does suggest, though, that modest expectations should be set with regard to impact. But this merely recognises that classroom practices are emerging and social, not the outcome of ‘belief enactment’. In this sense, PoP offers an explanation why belief research has not fulfilled the promise of its founders and solved ‘the problems of implementation’.

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